MECHANICAL VENTILATION ESSENTIAL DEFINITIONS

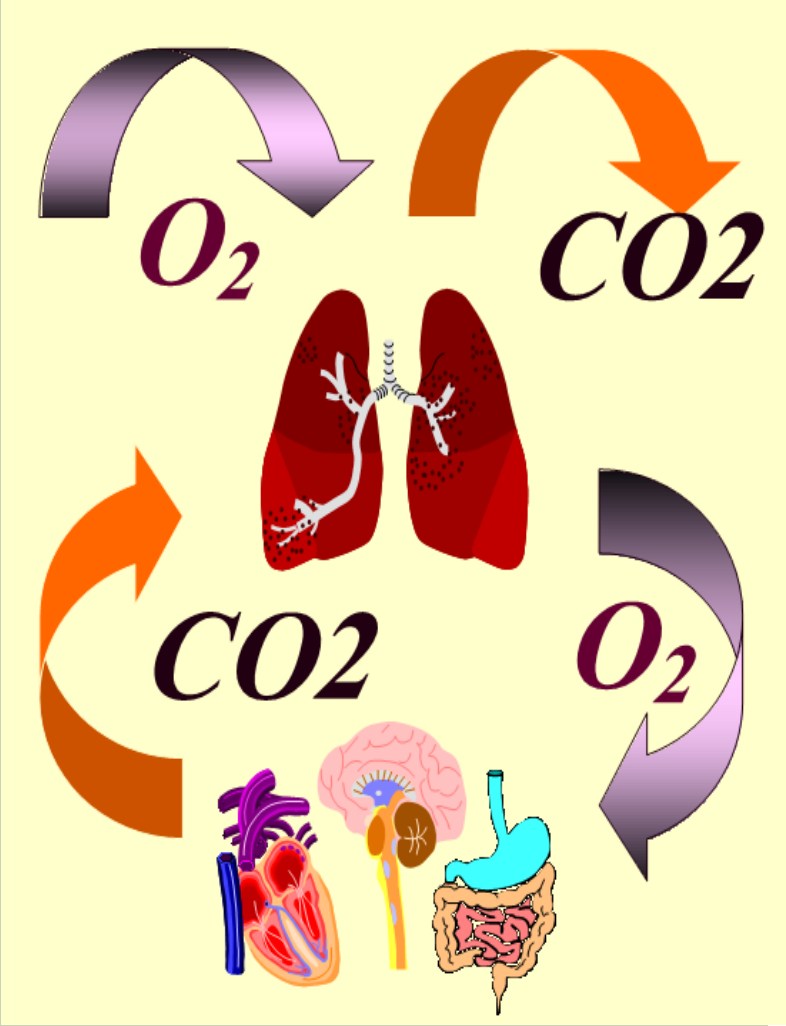
WHAT IS VENTILATION?

Spontaneous breathing or spontaneous ventilation, is simply the movement of air into and out of the lungs.

The main purpose of ventilation is to bring in fresh air for gas exchange into the lungs and to allow the exhalation of air that contains CO2.

WHAT IS RESPIRATION?

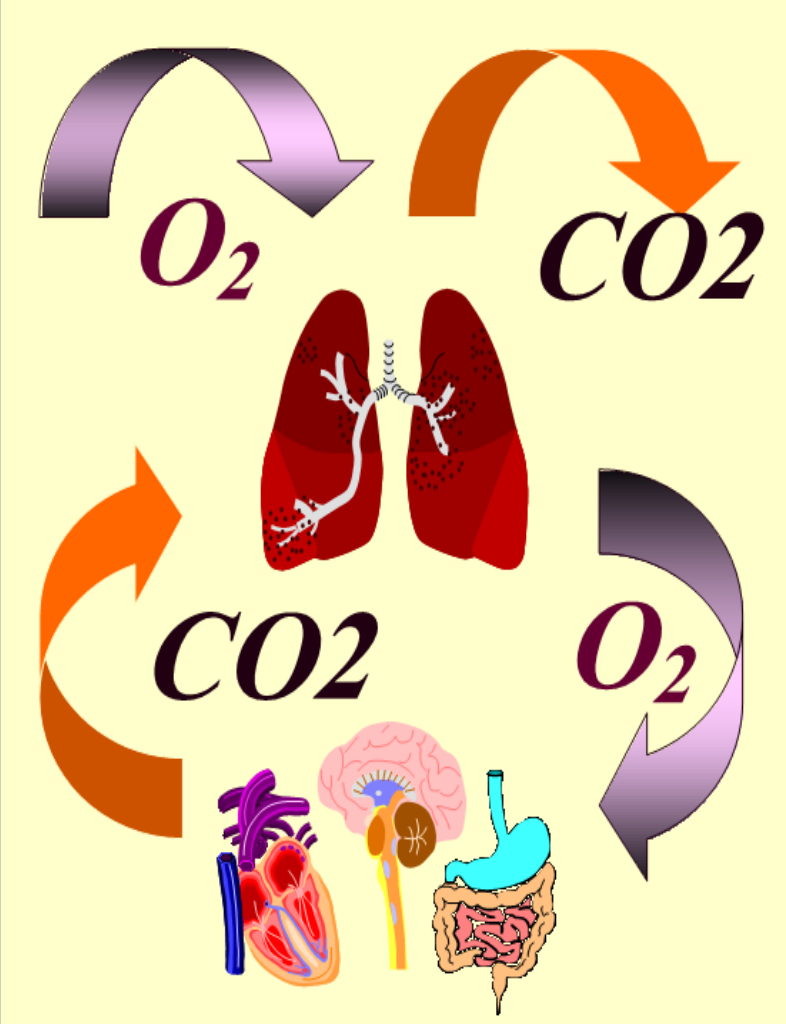
RESPIRATION is defined as movement of gas molecules across a membrane.



WHAT IS RESPIRATION?

EXTERNAL RESPIRATION is movement of O2 from the lungs into blood stream and of CO2 from bloodstream into alveoli.

INTERNAL RESPIRATION is movement of CO2 from the cells into the blood and movement of O2 from the blood into cells.



RESPIRTORY FAILURE

Inability of the pulmonary system to meet the metabolic demands of the body through adequate gas exchange.

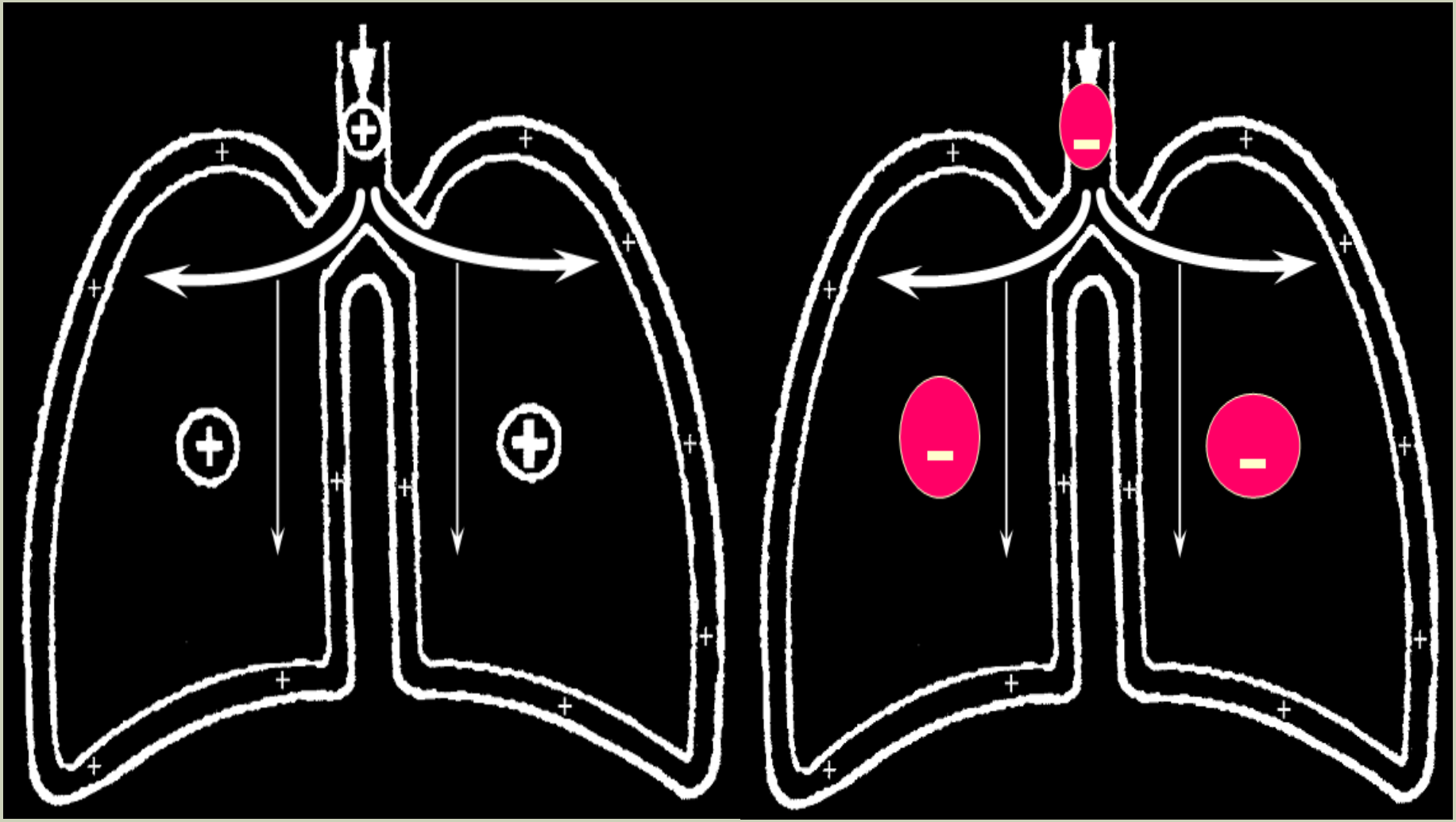
- Two types of respiratory failure:
= Hypoxemic
= Hypercarbic

- Management of this condition required assisted mechanical ventilation.

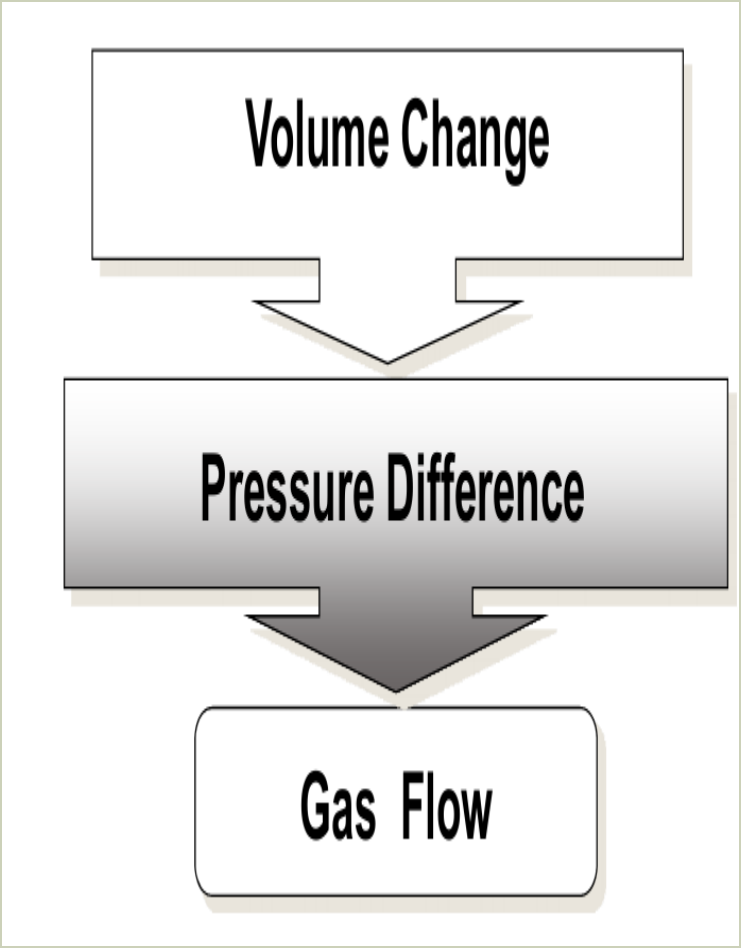
WHAT IS MECHANICAL VENTILATION?

Assisted Ventilation involves the Delivery of Flow and Pressure to the Patient's Airway in Order to affect Change in Lung Volume.

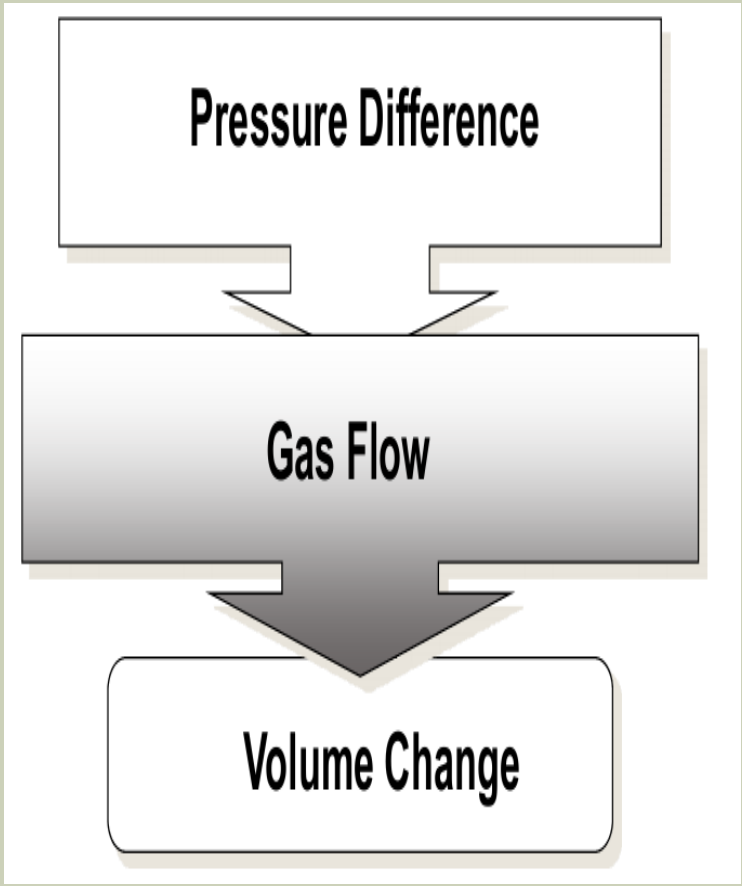
Mechanical Ventilation / Normal ventilation



Spontaneous inspiration



Mechanical inspiration



MECHANICAL BREATHS CAN BE DELIVERED IN INVASIVE OR NON INVASIVE WAY

Invasive ventilation
delivers ventilatory support through bypassing the upper airway with a tracheal tube, laryngeal mask, or tracheostomy.

Non-invasive ventilation (NIV)
refers to the provision of ventilatory support through the patient's upper airway using a mask or similar device.

TYPES OF VENTILATORS

CONVENTIONAL VENTILATORS

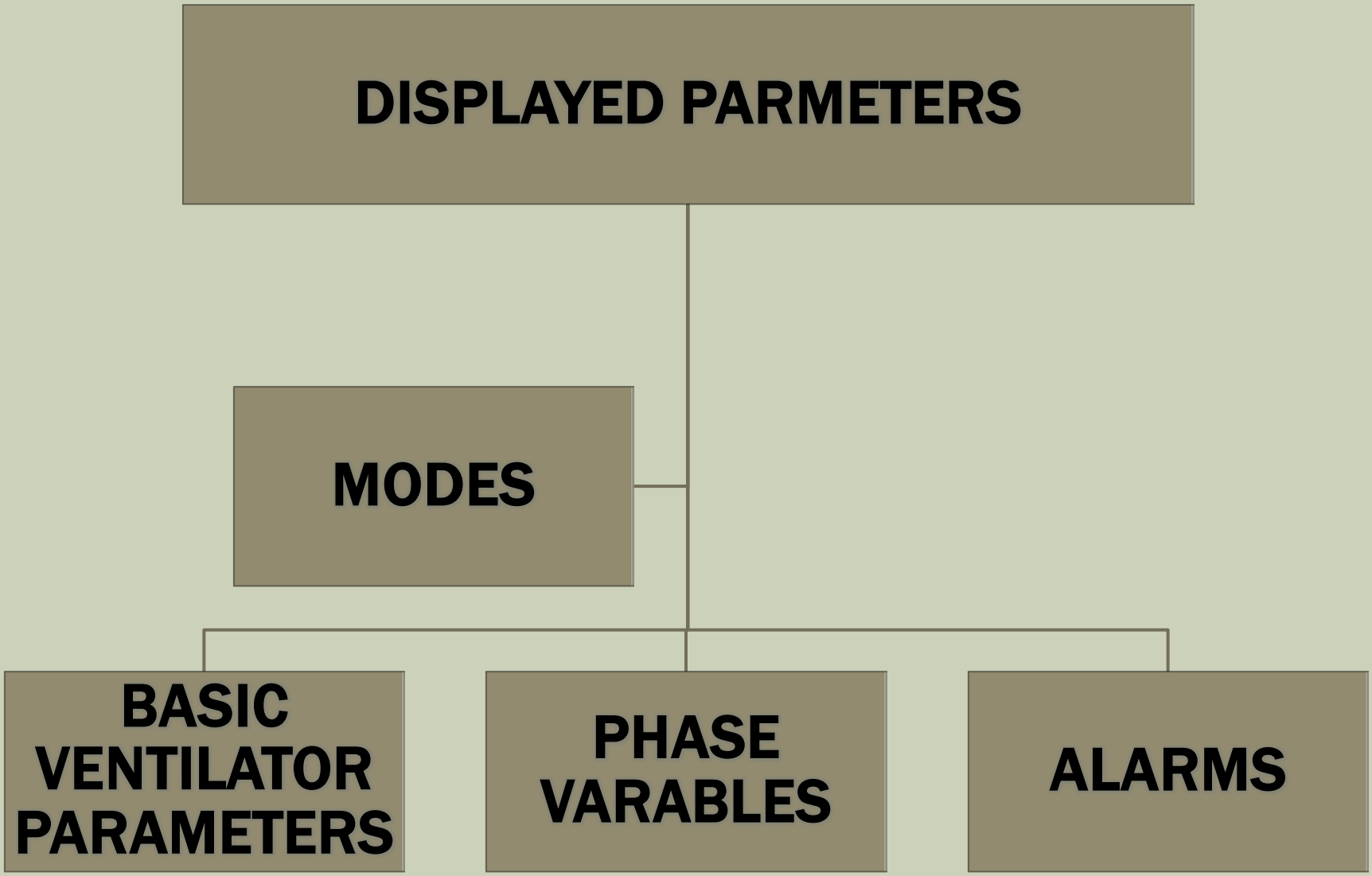
produce breathing patterns that mimic the way we normally breathe. They operate at breathing rates our bodies normally produce during our usual living activitiesThese are called

HIGH FREQUENCY VENTILATORS

produce breathing patterns at frequencies much higher than we would or could voluntarily produce for breathing-called. These ventilators can produce rates upto 15 Hz(900 breaths/minute).


(S)CMV
Adult
Patient
Additions
Modes
28 Ppeak cmH2O
7.0 ExpMinVol l/min
Paw cmH2O
40
20
0
-10
1 2 3 4 5 6 7 8 9 10
s
15 b/min
Rate
500 ml
Vt
10 cmH2O
PEEP/CPAP
100 %
Oxygen
Hold
P/V Tool
V ml
10
8
6
4
2
0
Paw cmH2O
0 10 20 30 40
End PEEP defines new PEEP after next maneuver.
Reconfirm if
- Ptop is greater than 40 cmH2O, or
- Tpause is greater than 5 s
0 cmH2O Pstart
3 cmH2O/s Ramp speed
30 cmH2O Ptop
0 s Tpause
10 cmH2O End PEEP
0 Vpeep ml
17 Tmaneuver s
Cursor 1 Cursor 2 Ccursors
ml/cmH2O ml/cmH2O ml/cmH2O
fl limb --- / --- --- / --- ---
efl limb --- / --- --- / --- ---
Cursor 1
Cursor 2
History

Start/Stop
Controls
Alarms
Monitoring
Graphics
Tools
Events
System
INT
AC


DISPLAYED PARMETERS
MODES
BASIC VENTILATOR PARAMETERS
PHASE VARABLES
ALARMS

BASIC VENTILATOR PARAMETERS

FIO_2

Fractional concentration of inspired oxygen delivered expressed as a % (21-100). The aim is apply the lowest O2 concentration to meet oxygenation goals.

Breath Rate (f)

The number of times over a one minute period inspiration is initiated (bpm).

BASIC VENTILATOR PARAMETERS

Inspiratory Time (I time)

The time spent in the inspiratory phase of the ventilatory cycle.

I:E Ratio

The inspiratory time compared to the expiratory time; I + E = total cycle time.

BASIC VENTILATOR PARAMETERS

Flow

The speed at which a volume of gas delivered, or exhaled, per unit of time.

Flow is described in liters per minute.

Tidal volume (V_T)

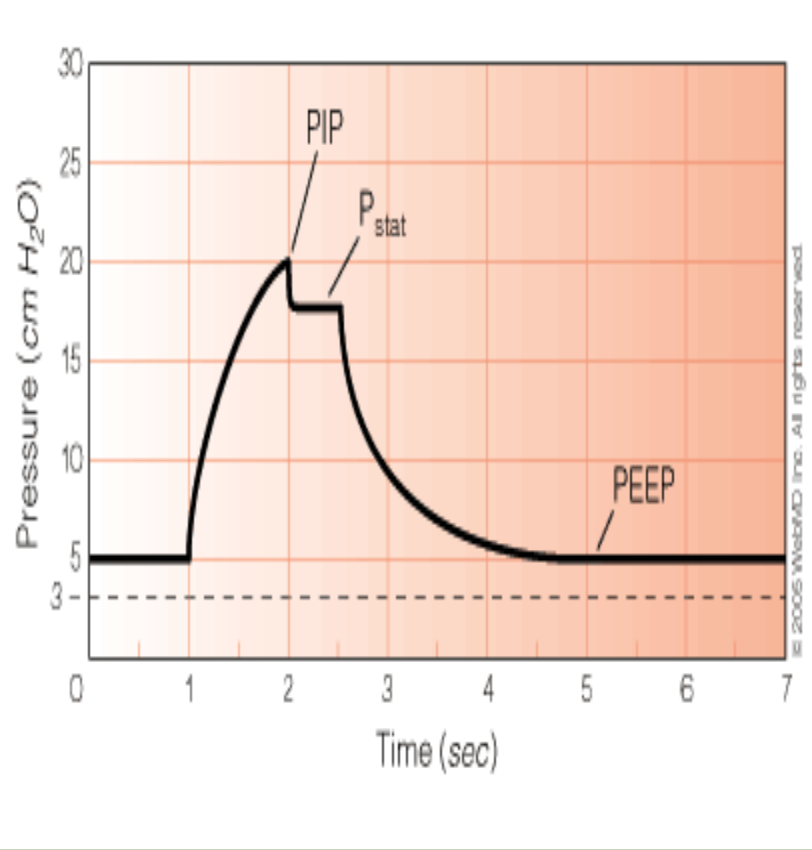
The amount of gas that is delivered during inspiration expressed in mls or Liters.

DEFINITION OF PRESSURES IN POSITIVE PRESSURE VENTILATION

Baseline Pressure

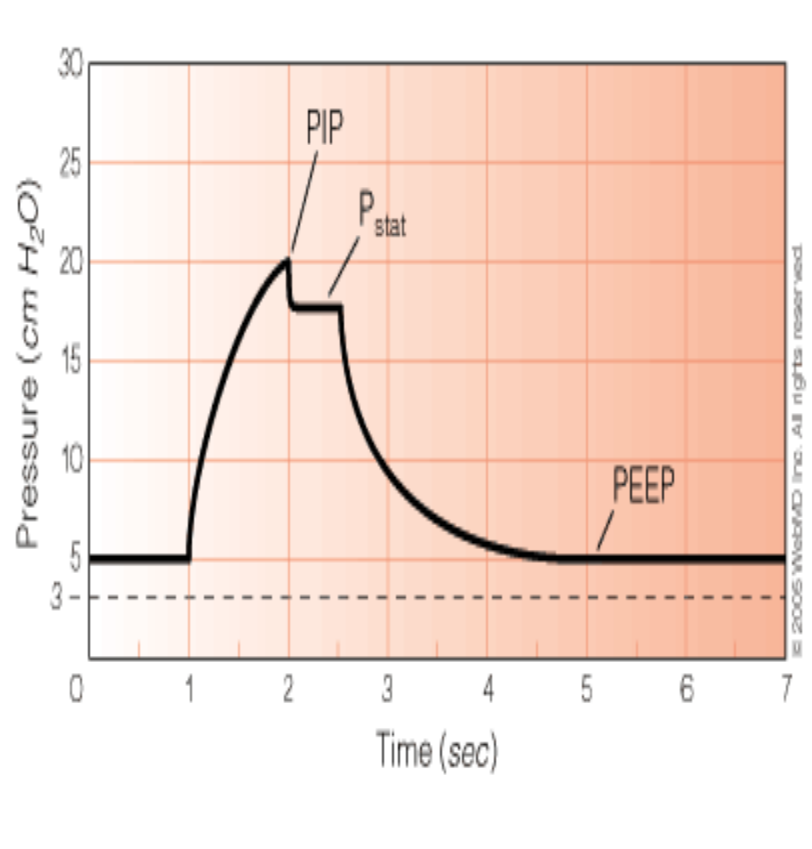
Pressures are read from a baseline value.

Normally the baseline pressure is zero (or atmospheric), which indicates that no additional pressure is applied at the airway opening during expiration and before inspiration.



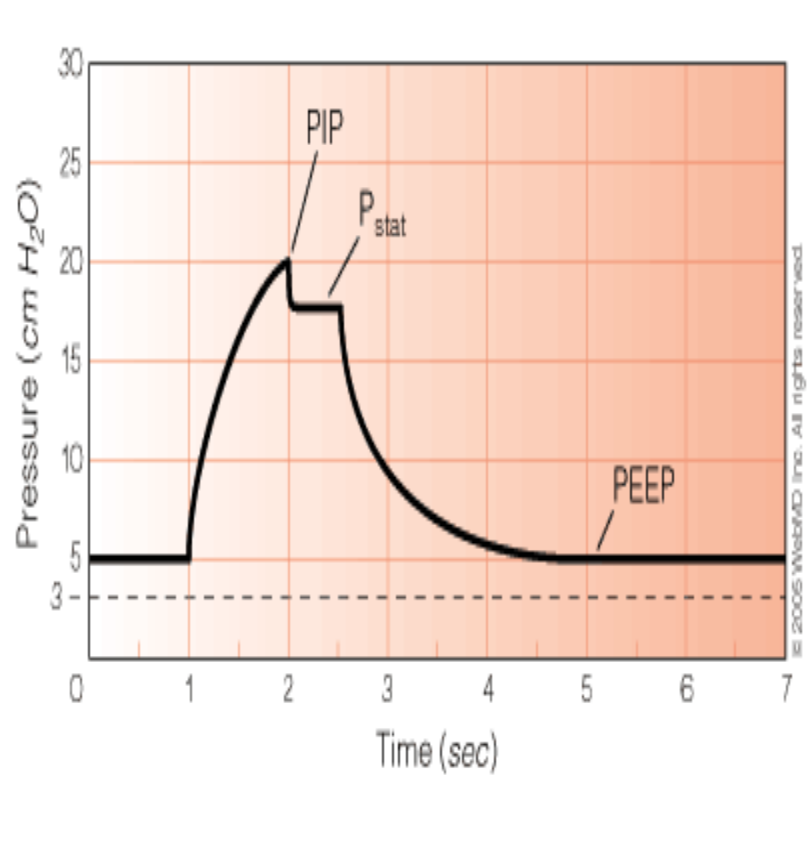
PEEP

Sometimes the baseline pressure is higher than zero, such as when the ventilator operator selects a higher pressure to be present during exhalation. This is called positive end-expiratory pressure, or PEEP.



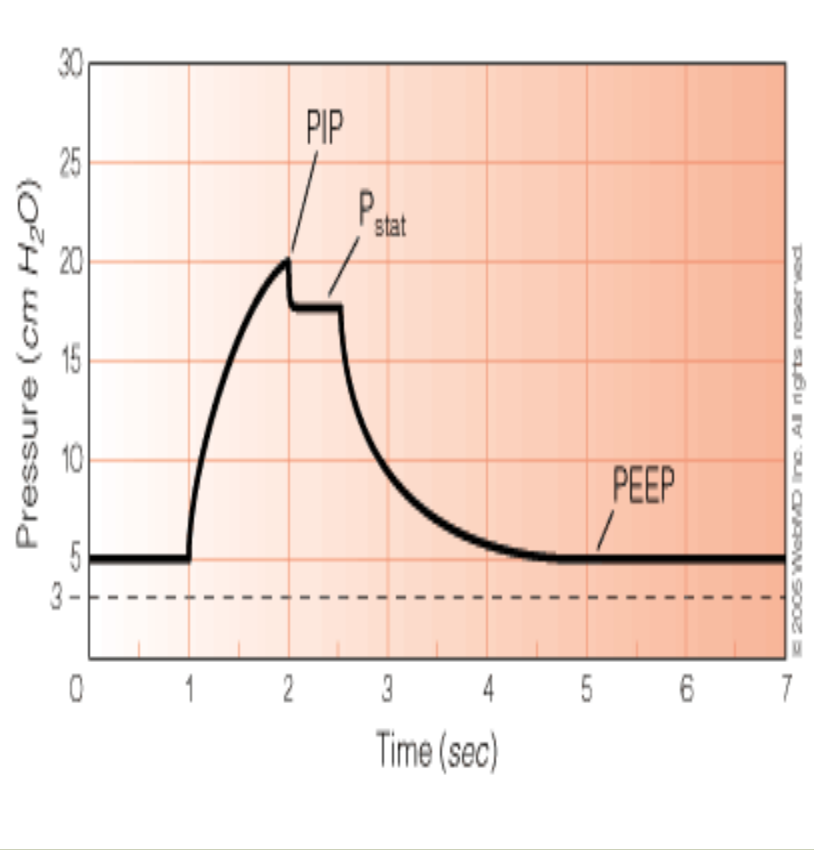
PIP

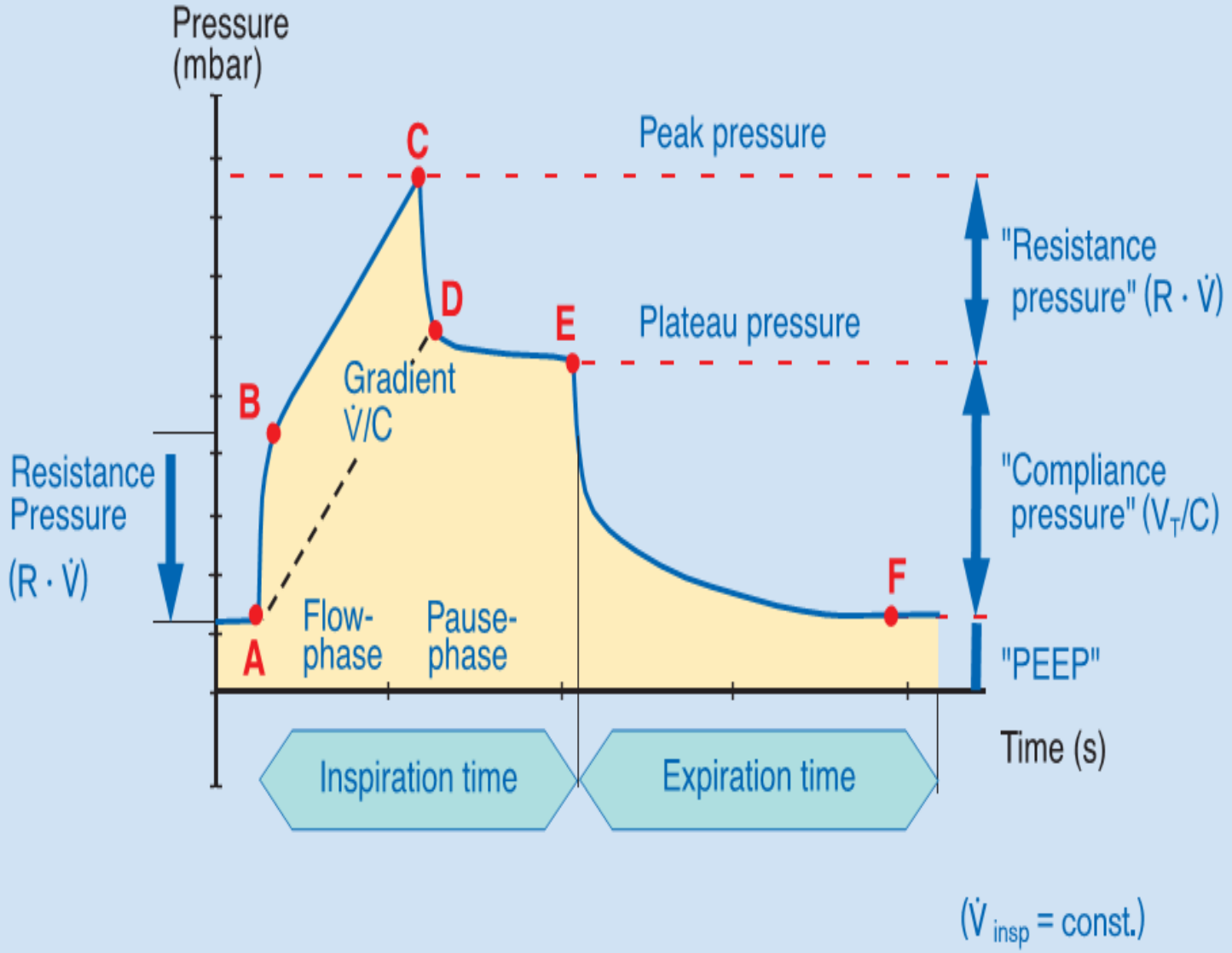
Peak inspiratory pressure is the highest pressure recorded at the end of inspiration. PIP is also called peak pressure (P_{Peak})or peak airway pressure.

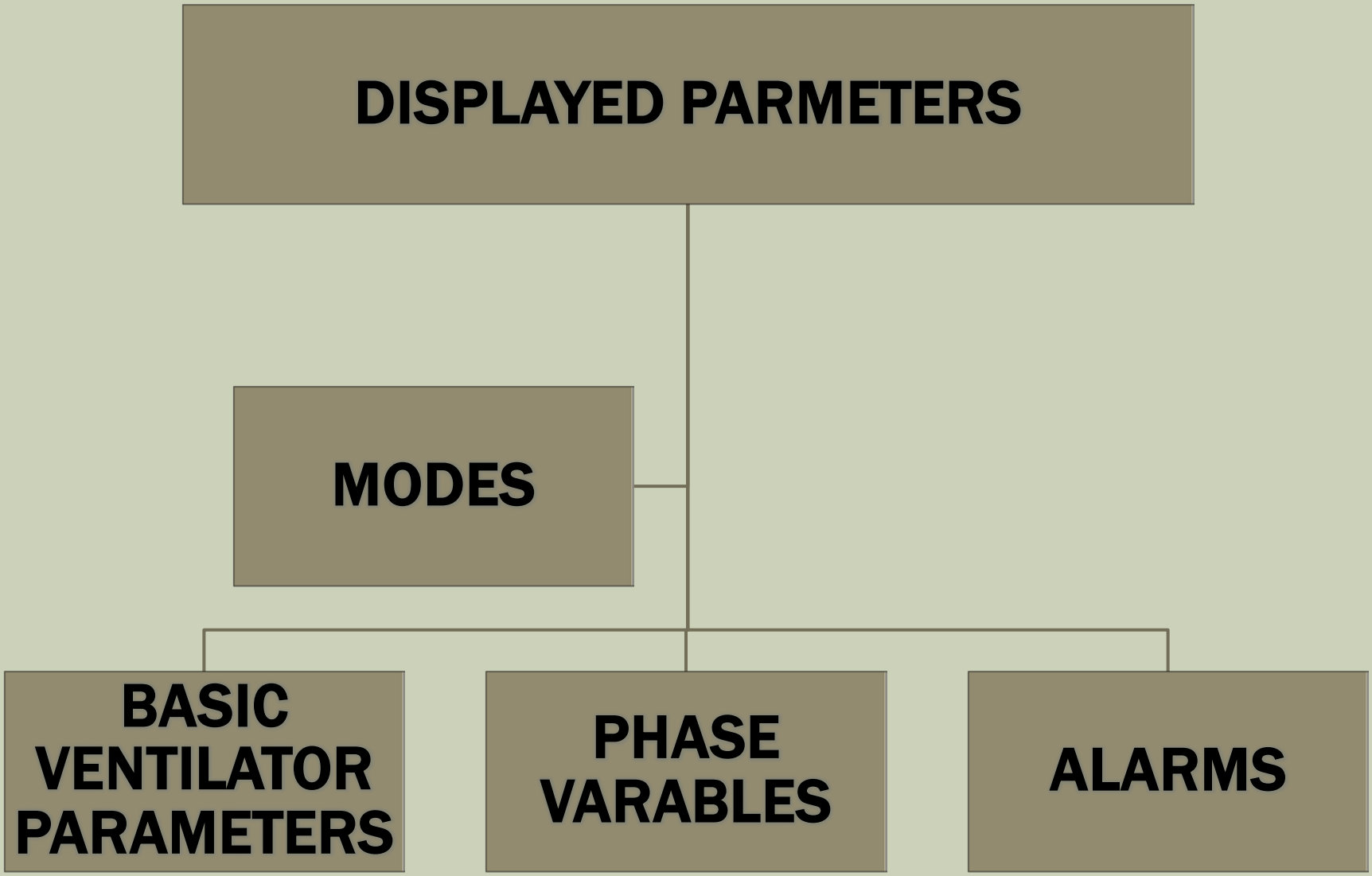


PLATEAU PRESSURE

The plateau pressure is measured after a breath has been delivered to the patient and before exhalation begins. Exhalation is prevented by the ventilator for a brief moment.




Pressure
(mbar)
C
Peak pressure
D
E
Plateau pressure
"Resistance
pressure" (R · V̇)
B
Gradient
V̇/C
Resistance
Pressure
(R · V̇)
"Compliance
pressure" (V_T/C)
F
A
Flow-
phase
Pause-
phase
"PEEP"
Time (s)
Inspiration time
Expiration time
(V̇ insp = const.)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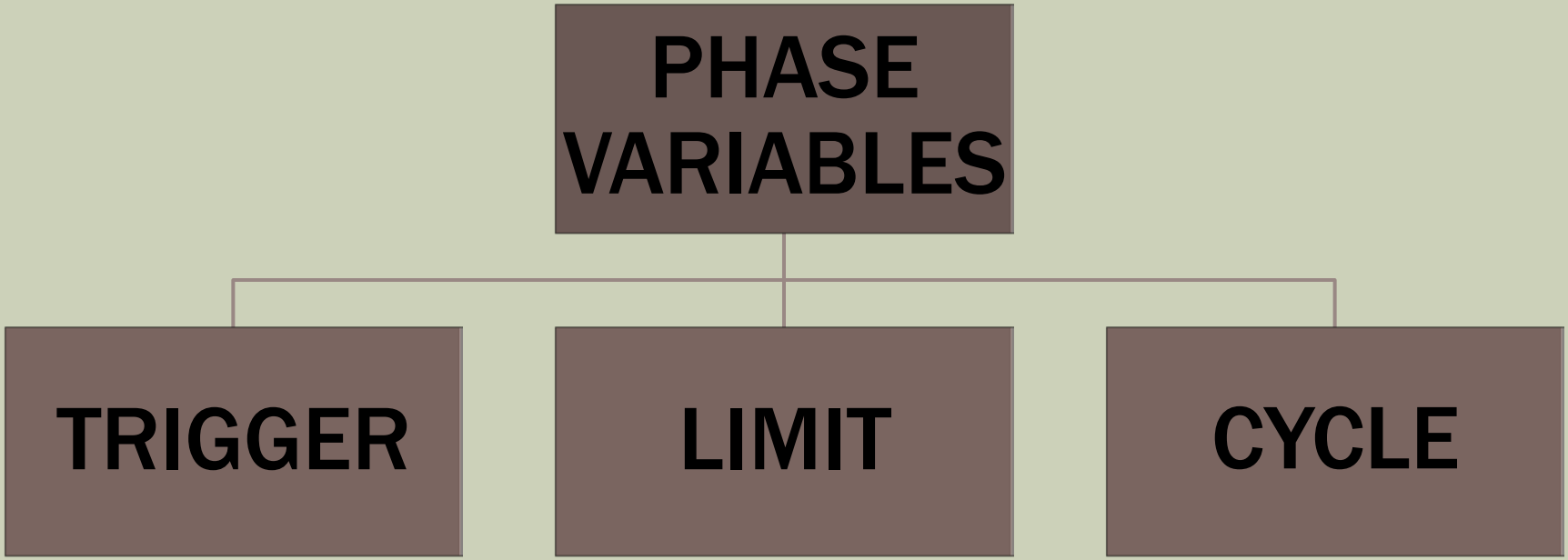
PHASE VARIABLES

The phase variable represents a signal measured by the ventilator. The machine uses the signal to begin some part of the breath. The trigger variable begins inspiration. The limit variable limits inspiratory factors. The cycle variable ends inspiration.

PHASES OF BREATH

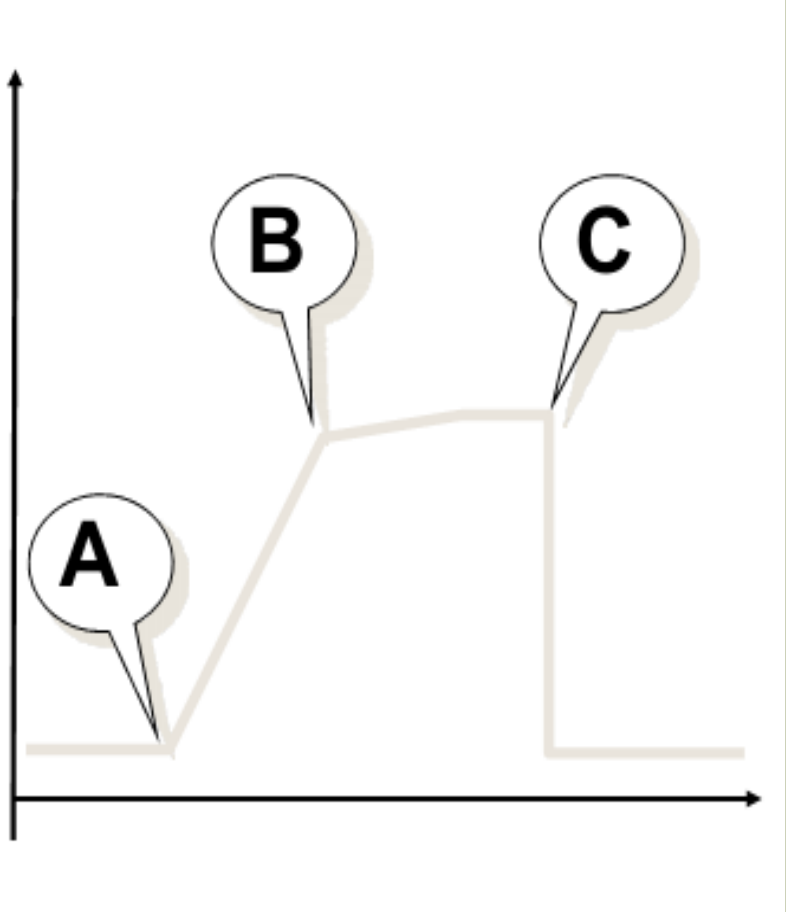
1. Change from exhalation to inspiration
2. Inspiration
3. Change from inspiration to exhalation
4. Exhalation


PHASE VARIABLES
TRIGGER
LIMIT
CYCLE

A. Trigger mechanism
What causes the breath to begin?
Patient (assisted)
Machine (controlled)

B. Limit variable
what limits the delivery of gas to the patient during the inspiratory phase {pressure or volume}.

C. Cycle mechanism
What causes the breath to end?
what cycles, or changes, the ventilator from one phase of the respiratory cycle to the other



TRIGGER VARIABLE- START OF A BREATH

The mechanism the ventilator uses to end exhalation and begin inspiration is the trigger mechanism (trigger variable).
The ventilator can trigger itself (**time triggering**), or the patient can trigger the machine (**patient triggering**) based on pressure, flow, or volume changes. Most ventilators also allow the operator to trigger a breath manually.

A. Trigger mechanism
What causes the breath to begin?
Patient (assisted)
Machine (controlled)

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what limits the delivery of gas to the patient during the inspiratory phase {pressure or volume}.

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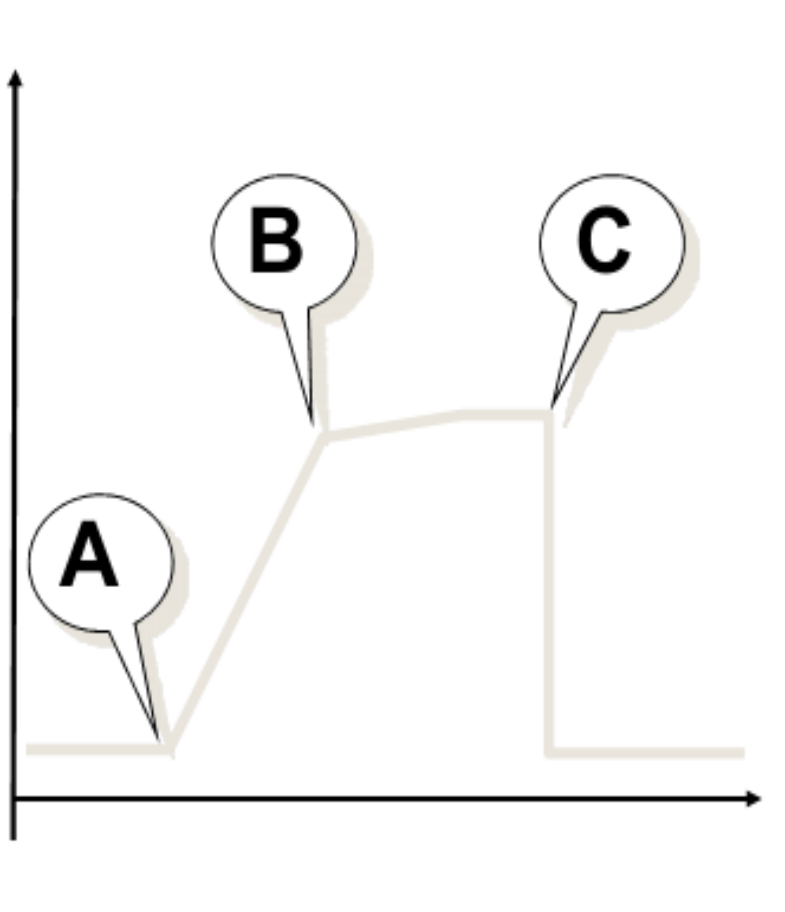

THE LIMIT VARIABLE

A limit variable is the maximum value a variable (pressure, volume, flow, or time) can attain. This limits the variable during inspiration but does not end the inspiratory phase.

A. Trigger mechanism
What causes the breath to begin?
Patient (assisted)
Machine (controlled)

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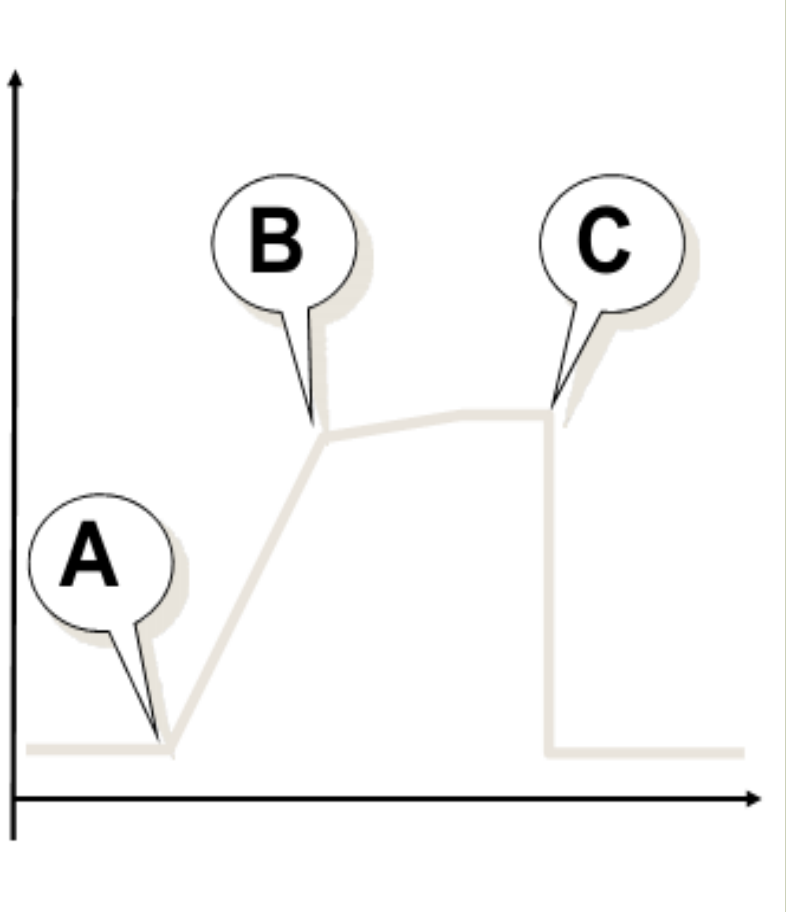
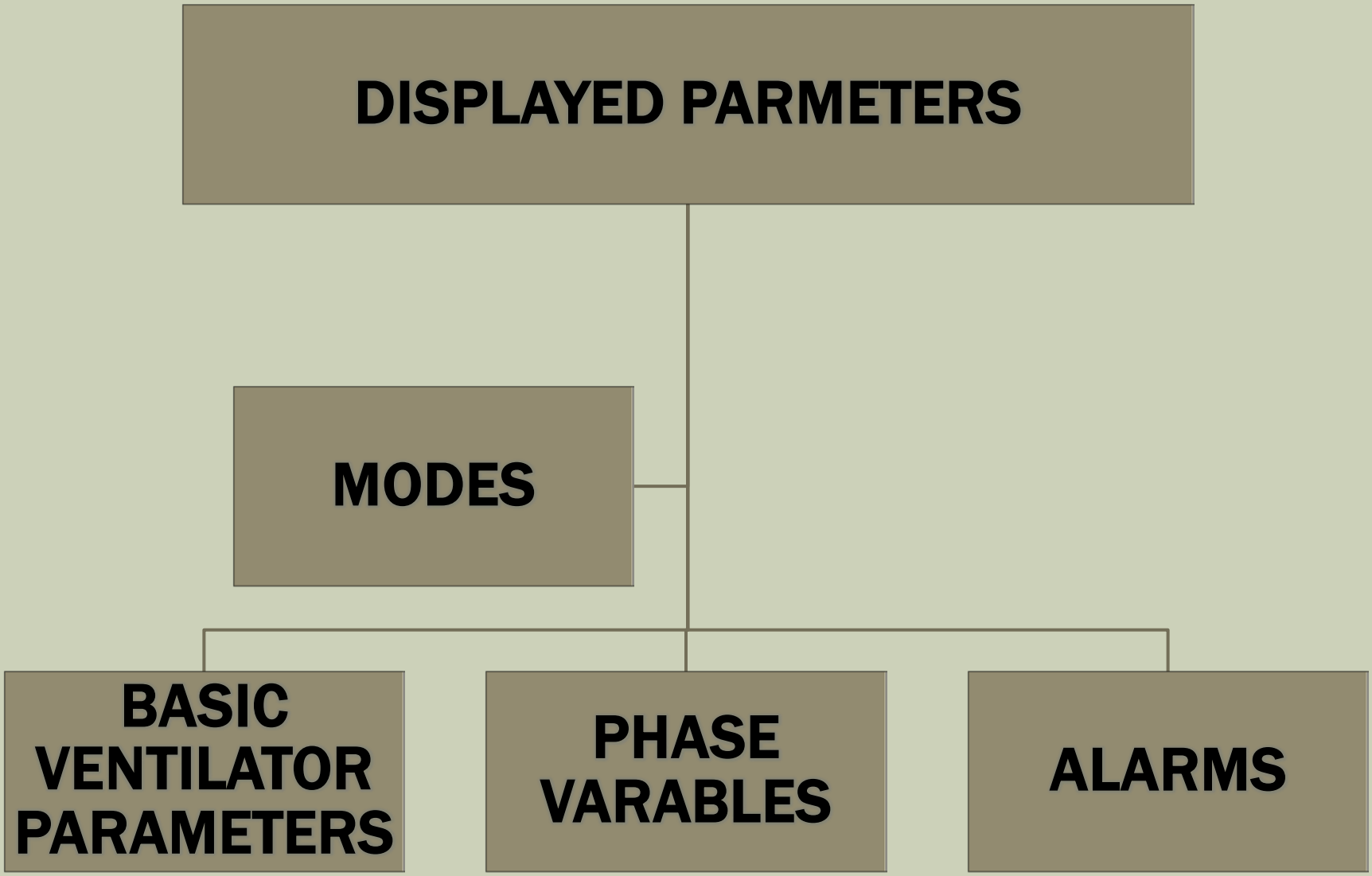


CYCLE VARIABLE

The variable a ventilator measures to determine the end of inspiration is called the cycling mechanism. Once cycling occurs, expiratory gas flow can begin.

EXAMPLE, a ventilator is set for pressure ventilation, with the pressure set at 25 cm H20. The inspiratory time is set at 2 seconds. Inspiration ends when 2 seconds has passed. The maximum pressure that can be attained during inspiration is 25 cm H20. Such a breath therefore is described as a pressure-limited, time-cycled breath (cycling ends inspiration). Reaching the set limit variable does not end inspiration; however, reaching the set time does end inspiration (time cycling).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MODES OF VENTILATION

The manner or method of support provided by the ventilator.

The breath type and pattern of breath delivery during a mechanical ventilation constitutes the "mode" of ventilation.

The mode is determined by the following factors:

Targeted control variable (volume or pressure)

Type of breath (mandatory, spontaneous, assisted, supported)

Timing of breath delivery (continuous mandatory ventilation [CMV], SIMV, or spontaneous).

CONTROL VARIABLE

By choosing either volume or pressure ventilation, the clinician determines the control variable that will be used to establish gas flow to the patient . Control variables are independent variables; in volume- targeted ventilation, for example, the volume provided is constant and independent of what happen to pressure and vice versa.

TYPE OF BREATH DELIVERY

Mandatory

Ventilator does the work

Ventilator controls start and stop

Spontaneous

Patient takes on work

Patient controls start and stop

Assisted

Patients triggers the breath

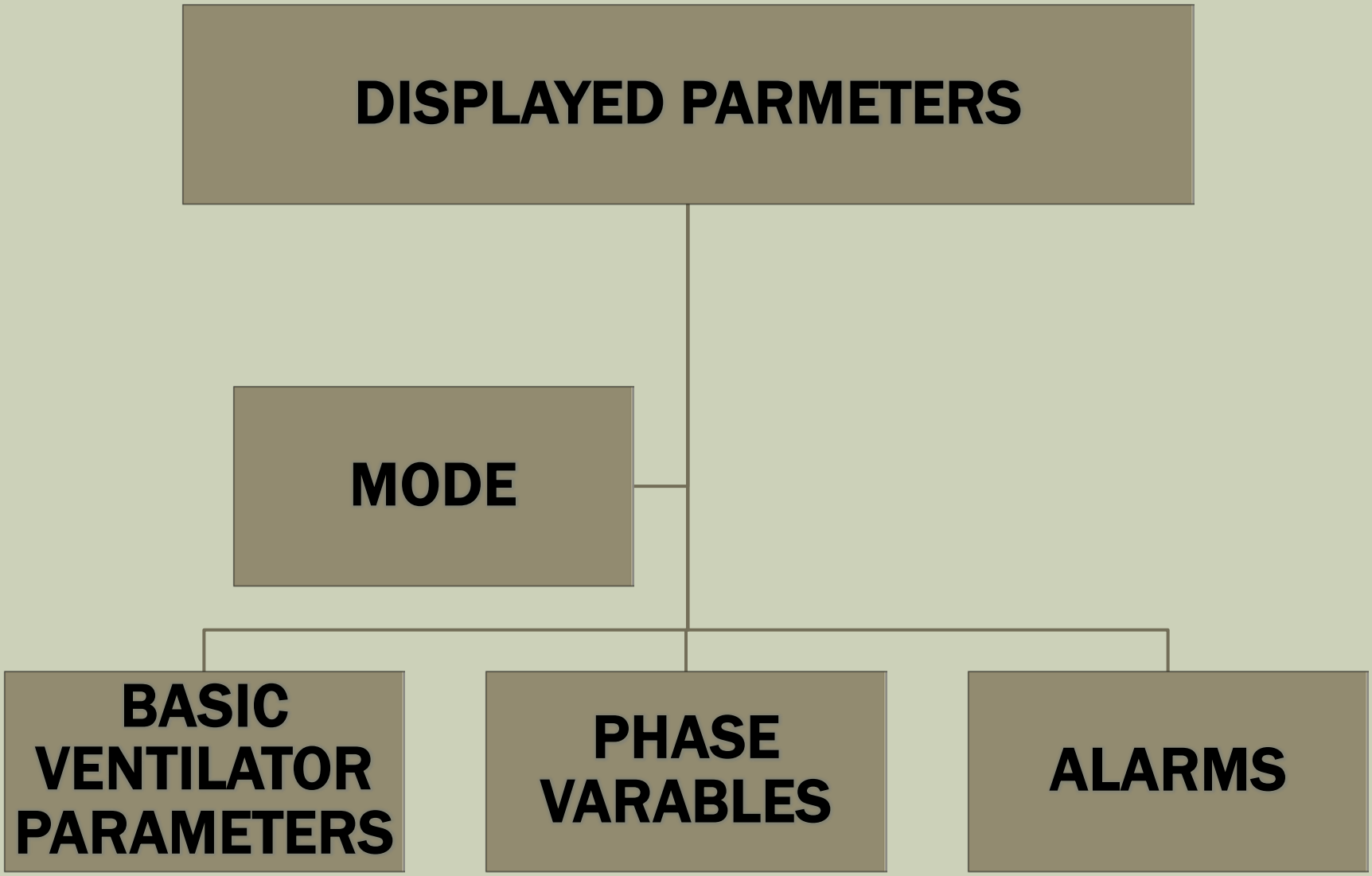
The ventilator delivers the breath as per control variable

Supported

Patients triggers the breath

Ventilator delivers pressure support

Breath cycles at set flow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ALARMS

Alarms warn of possible dangers related to ventilator system.

ALARMS

Alarms warn of possible dangers related to ventilator system.

There are three basic types of alarms

1-input power alarms

2-Control circuit alarms

3-Output alarms

INPUT POWER ALARMS

Loss of electrical power

Ventiators typically have alarms that are activated if the electric power is cut off while the machine is switched on.

Loss of pneumatic power

Ventilators that use pneumatic power have alarms that are active if either the oxygen or air supply is cut off or reduced below specified driving pressure.

CONTROL CIRCUIT ALARMS

Either

Set control variable parameters are incompatible (perhaps inverse I:E ratio)

Some aspect of ventilator self test has failed.

OUTPUT ALARMS

Output alarms are activated when the value of a control variable(pressure, volume, flow or time) falls outside an expected range.

Pressure

High and low air way presure

High and low baseline pressure

High and low mean airway pressure

Volume

High and low exhaled volume

OUTPUT ALARMS

Flow

High and low expired minute volume

Time

High and low ventilatory frequency

Inappropriate inspiratory time

Inappropriate expiratory time

LAST MESSAGE

- The science of mechanical ventilation is to optimize gas exchange.
- The art is to achieve that without damaging the lung.


THANK YOU